

VASCULAR FLORA OF THE WETLAND AND
PRAIRIE COMMUNITIES OF GAVIN BOG
AND PRAIRIE NATURE PRESERVE,
LAKE COUNTY, ILLINOIS

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ABSTRACT

The vascular flora of the wetland and graminoid plant communities at Gavin Bog and Prairie Nature Preserve in Lake County, Illinois, is described. A total of 246 vascular plant species and three hybrids was found in four broad community classes: bog, marsh, sedge meadow, and prairie. Three bog communities, low-shrub zone, tall-shrub zone, and forested-bog zone, were recognized. The prairie primarily includes wet prairie and mesic prairie. Fifteen threatened or endangered plant species for Illinois were recorded from the nature preserve including two, *Carex brunnescens* and *Vaccinium oxycoccos*, not accurately reported from Illinois before this study.

Gavin Bog is an oligotrophic acid peatland in an advanced developmental stage. Although the two major plant families characteristic of acid peatlands in the Great Lakes region, Cyperaceae and Ericaceae, are also the best-represented families at Gavin Bog, little compositional similarity exists between Gavin Bog and marsh and other bog/marsh communities in Lake County, Illinois.

A total of 5.7% of the vascular flora at Gavin Bog and Prairie Nature Preserve is alien to North America. One exotic species, glossy buckthorn (*Rhamnus frangula*), currently dominates the tall-shrub zone in the bog, occurs throughout the forested zone, and is threatening the low-shrub zone. The presence of this species has probably resulted in ecological shifts favoring shade-tolerant species throughout the bog. Ecological consequences of various management options are considered.

Key Words: bog, prairie, sedge meadow, marsh, *Carex canescens*, *Vaccinium oxycoccos*, *Rhamnus frangula*, fire, management, Gavin Bog and Prairie Nature Preserve, Illinois

INTRODUCTION

Bogs are an uncommon community type in Illinois and are restricted to the Northeastern Morainal Natural Division (Schwegman, 1973). Twelve bogs, including Gavin Bog, were identified by the Illinois Natural Areas Inventory (INAI) as significant natural features (White, 1978). These bogs, representing four natural communities (graminoid-bog, low-shrub, tall-shrub, and forested-bog), contain a distinctive flora that includes many

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boreal species at the southern limits of their Midwestern ranges. Consequently, numerous bog species are rare in the state, and several are listed as Threatened or Endangered in Illinois (Sheviak, 1981). With the exception of Volo Bog, the only Illinois bog containing the classic floating herb mat surrounding an open water pond (Sheviak and Haney, 1973), the vegetational composition of Illinois bogs has been poorly documented. Early accounts of the vegetation of several Illinois bogs were given by Waterman (1921, 1923, 1926) and Wascher (1934, M.S. thesis, University of Illinois, Champaign-Urbana). Voss (1934) described the Pleistocene vegetation of several Illinois and other Midwestern bogs through pollen analysis. The paucity of contemporary vegetation descriptions for Illinois bogs prompted the present study in which we document the vegetation composition of wetland and prairie communities at Gavin Bog and Prairie Nature Preserve.

STUDY AREA

Gavin Bog and Prairie Nature Preserve contains an oligotrophic peatland (Johnson, 1985), or bog, surrounded by emergent wetland, prairie, and forest communities. Upland forest communities were not included in this floristic study. The nature preserve lies 2 km (1.3 miles) east of Fox Lake in Lake County, Illinois (Figure 1), and encompasses 55 hectares (136.5 acres). A dedicated Illinois Nature Preserve, the area is owned and managed by the Lake County Forest Preserve District.

Gavin Bog and Prairie Nature Preserve lies in a depression on the western edge of the Valparaiso Moraine, a Wisconsinan-age end moraine (Willman, 1971). Part of the area occurs on Wadsworth till of the Wedron formation, a till of mainly clay and silty clay (Willman, 1971; Lineback, 1979). The bog is underlain by Grayslake Peat, a peat deposit containing some organic silts that formed on former lake basins (Willman, 1971). Houghton muck soil is found in the bog and in parts of the marsh and prairie; Peotone silty clay loam soil underlies sedge meadow, marsh and prairie vegetation. Both soils are very poorly drained and formed on level or depressional sites (Paschke and Alexander, 1970).

The preserve has been managed by the Lake County Forest Preserve District since 1977, and the prairie was burned annually in the spring until 1983. Since that time, management fires have been conducted in alternate years, and brush has been removed.

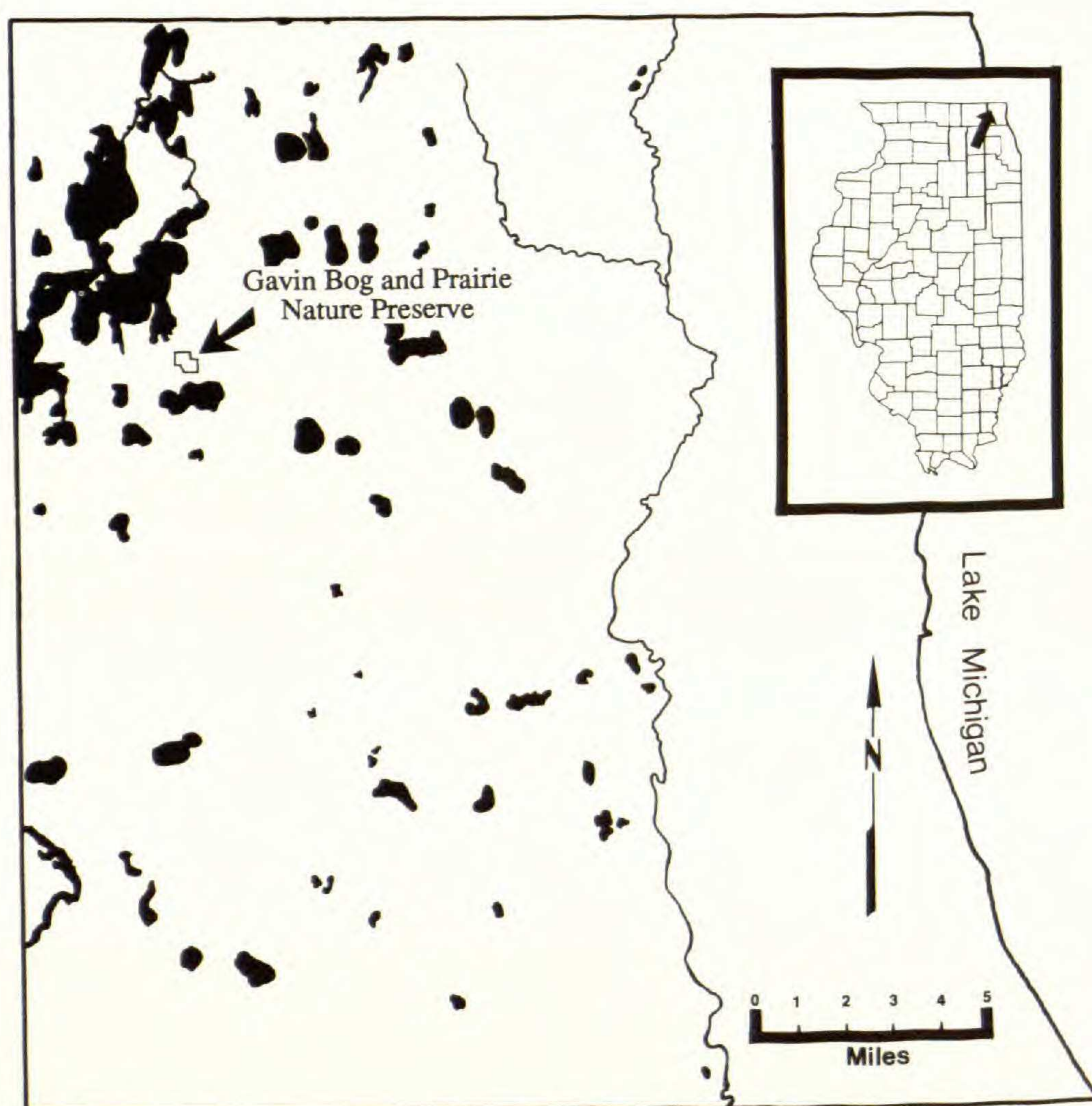


Figure 1. Location of Gavin Bog and Prairie Nature Preserve in Lake County, Illinois. Lakes and the principal rivers are shown in black.

Past disturbances include cattle grazing in the bog prior to 1960, and attempts at draining some of the wetlands. A drainage ditch adjoining the prairie was filled in 1984.

METHODS

Seven site visits were made to the study area between July 1985 and May 1989. At these times, species were noted and their habitats and relative abundance (e.g., abundant, common, occasional, uncommon, rare) were estimated. All communities were visited in spring, summer, and autumn. Natural communities were classified following White (1978). Collections were made of species that could not be field identified or were state records; these are

deposited in ILLS. The nomenclature and phylogenetic order used in the checklist of species (Appendix) follow Mohlenbrock (1986), with the exception of two species unreported from the state prior to 1986; in those instances, nomenclature follows Swink and Wilhelm (1979).

Sorensen's Index of Similarity (Mueller-Dombois and Ellenberg, 1974) was used to compare species occurring in the marsh and bog communities at Gavin Bog (115 species) with those on species lists compiled for three other Illinois bogs and one Indiana bog that also include marsh vegetation. Marsh communities were included because in some cases the bog/marsh border is poorly defined. The four other sites were Wauconda Bog (136 species), list compiled by Robert Evers, Galen Smith, Gerald Paulson, Floyd Swink, Michael Madany, Keith Wilson, and Robbin Moran between 1947 and 1977 (Illinois Natural History Survey and INAI files); Volo Bog (106 species), list compiled during intensive sampling by Charles Sheviak and Alan Haney (1973); Barrington Bog (75 species, including sedge meadow), list compiled by Wayne Schennum (Illinois Nature Preserve Commission files); and Pinhook Bog (168 species) in La Porte County, Indiana, list compiled by Gerould Wilhelm with Marlin Bowles, James Aldrich, Ken Dritz, Norm Henderson, Craig Johnson, and Elizabeth Shimp from 1979 through 1988 (Wilhelm, 1980).

To date the dominant woody vegetation in the bog, the age of a selected tamarack (*Larix laricina* (DuRoi) K. Koch) was estimated by counting growth increments of a core removed with an increment borer. The age of an individual glossy buckthorn (*Rhamnus frangula* L.) was estimated from growth increments on a basal stem segment removed with a hack saw.

RESULTS AND DISCUSSION

Community Descriptions

Seven wetland and prairie plant communities occur at Gavin Bog and Prairie Nature Preserve: forested bog, tall-shrub bog, low-shrub bog, marsh, sedge meadow, wet prairie, and mesic prairie. Species composition, with relative abundance estimates and the associated plant communities, is compiled in the Appendix.

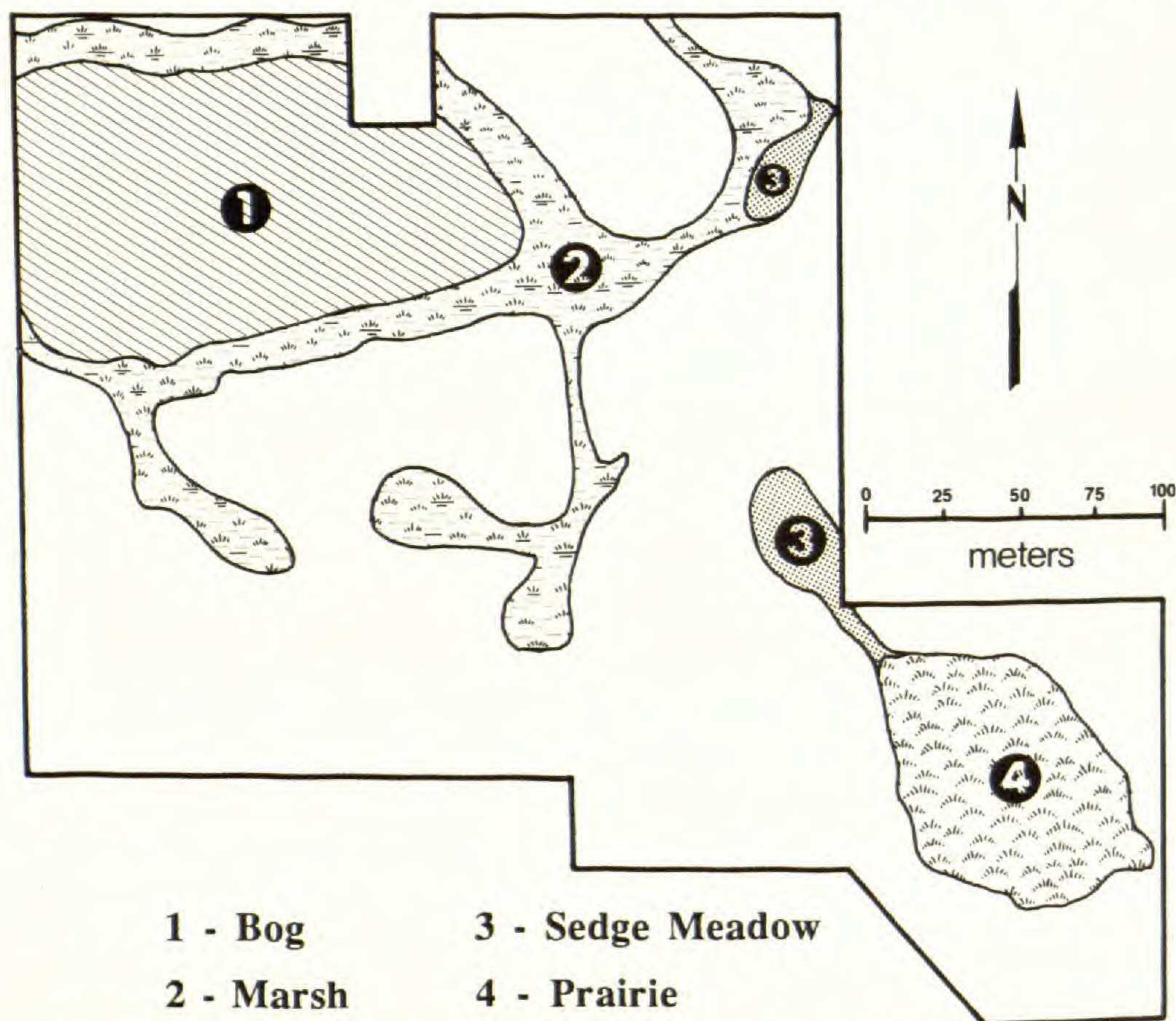


Figure 2. Wetland and prairie plant communities of Gavin Bog and Prairie Nature Preserve, Lake County, Illinois.

The bog communities contain a central ellipse of forested bog bordered by a broad, concentric band of tall-shrub bog. A small low-shrub bog community occurs near the north-central edge of the forested bog. The open water pool and floating herb mat characteristic of many bogs with earlier successional stages (Sheviak and Haney, 1973; Johnson, 1985) are absent from Gavin Bog. The depression containing Gavin Bog was completely peat-filled before 1934 (Voss, 1934). A marsh community borders the tall-shrub bog as a concentric ring, with narrow lobes formed to the south and east. A sedge meadow borders the east lobe of the marsh. A second sedge meadow and wet and mesic prairie communities occur to the south-southeast. These latter graminoid communities are separated from the bog and marsh by successional fields and upland forest (Figure 2).

BOG COMMUNITIES. Hummocks colonized by the mosses *Sphagnum* spp. (including *S. centrale* C. Jens.), *Aulacomnium*

palustre (Hedw.) Schwaegr., and *Calliergon* sp. characterize all bog communities. The forested bog is dominated by *Larix laricina* in the canopy. This species was present in the early 1930's (Voss, 1934). A core from an increment borer of one of the largest individuals in the bog today (18 cm dbh) had about 61 growth increments. This finding suggests that tamaracks probably persisted at the site despite a pathological infestation of bark beetles on tamarack in the region (Shelford, 1963). A dense understory of the exotic shrub *Rhamnus frangula* occurs throughout the forested zone. The native shrubs *Ilex verticillata* (L.) Gray, *Vaccinium corymbosum* L., and *Gaylussacia baccata* (Wang.) K. Koch are occasional to common; *Vaccinium myrtilloides* Michx. is uncommon and *Ribes hirtellum* Michx. is rare. Common-to-occasional groundcover species are *Carex brunnescens* (Pers.) Poir. var. *sphaerostachya* (Tuckerm.) Kukenth., *Carex trisperma* Dew., and *Trientalis borealis* Raf. The tall-shrub bog is a dense, nearly impenetrable, zone dominated by *Rhamnus frangula* with *Ilex verticillata* common to occasional and *Aronia melanocarpa* (Michx.) Ell. locally common. *Betula pumila* L. is present but rare. Herbaceous species include *Carex trisperma*, *C. brunnescens*, *Dulichium arundinaceum* (L.) Britt., *Osmunda cinnamomea* L., *O. regalis* L., and the exotic *Lythrum salicaria* L. The low-shrub bog forms a distinctive zone characterized by dense *Chamaedaphne calyculata* intermixed with *Gaylussacia baccata*, *Rhamnus frangula*, *Eriophorum virginicum* L., *Carex trisperma*, and *Vaccinium oxycoccos* L., a species previously unverified from Illinois (see section on state-listed plant species).

In May 1989, several white oak (*Quercus alba* L.) seedlings were observed on *Sphagnum*-covered hummocks throughout the forested-bog zone. These hummocks were drying out in May 1989, and water levels in the bog were the lowest observed since 1985 when this study began. We believe the appearance of the oak seedlings is a response to a drought-induced lowering of the water table and not an indication of succession toward a more mesophytic forest community. Gavin Bog, like Volo Bog (Sheviak and Haney, 1973), provided no salient evidence of change toward a more mesophytic forest community, despite its advanced stage of development.

A few characteristic bog species that we did not find are reported from Gavin Bog (Broulliard, Lake County Forest Preserve District, pers. comm.). These include *Toxicodendron vernix* (L.)

Kuntze, *Rhamnus alnifolia* L'Her., and *Sarracenia purpurea* L. (observed in 1974 by Charles Sheviak, INAI files). *Andromeda glaucophylla* Link was collected from a "cranberry marsh, [in] open places in tamarack swamp" by E. J. Hill in 1908 in Grant Township. This site may have been Gavin Bog since other Hill collections with similar site descriptions include taxa known or formerly known from Gavin Bog, also in Grant Township. These taxa, if still present, occur at low population levels.

MARSH COMMUNITY. *Typha latifolia* L. strongly dominates the marsh. *Sium suave* Walt. and the introduced species *Lythrum salicaria* (purple loosestrife) and *Solanum dulcamara* L. are common. Purple loosestrife has not yet reached the alarming densities found in similar wetland sites in northeastern Illinois. Common-to-occasional associates include *Acorus americanus* (Raf.) Raf., *Carex scoparia* Schkuhr, *Carex lanuginosa* Michx., *Eleocharis erythropoda* Steud., *Equisetum fluviatile* L., *Lysimachia thyrsiflora* L., *Lycopus uniflorus* Michx., *Phalaris arundinacea* L., *Polygonum amphibium* L., and *Sparganium eurycarpum* Engelm. *Veronica scutellata* L. is present, but rare.

SEDGE MEADOW. The sedge meadow is characterized by a wide variety of graminoid species. The dominant sedge and grasses are *Carex stricta* Lam., *Calamagrostis canadensis* (Michx.) Beauv., and *Spartina pectinata* Link; common-to-occasional species include *Carex buxbaumii* Wahlenb., *C. festucacea* Schkuhr, *C. lacustris* Willd., *Glyceria striata* (Lam.) Hitchc., *Scirpus acutus* Muhl., and *Iris shrevei* Small. The State-threatened sedge *C. atherodes* Spreng., a species that superficially resembles *C. lacustris*, is reported to be common in this community (Bowles, 1988; unpublished report, Morton Arboretum, Lisle, IL). Although no dicot herbs are dominant here, many characteristic species are present, including *Asclepias incarnata* L., *Campanula aparinoides* Pursh., *Galium boreale* L., *Lathyrus palustris* L., and *Ranunculus flabellaris* Raf.

PRAIRIE COMMUNITIES. Wet prairie occurs in slightly depressed parts of the prairie and mesic prairie occurs on slightly elevated sites. Dominant species in the wet prairie are *Calamagrostis canadensis*, *Carex stricta*, and *Spartina pectinata*. Associates include *Aster simplex* Willd., *Saxifraga pensylvanica* L., *Spiraea alba* DuRoi, *Stachys palustris* L., and *Veronicastrum virginicum* (L.)

Farw. The mesic prairie has a greater abundance and diversity of dicot herbs than the wet prairie. Characteristic species of the mesic prairie are *Andropogon gerardii* Vitman, *Aster novae-angliae* L., *Castilleja coccinea* Spreng., *Comandra umbellata* (L.) Nutt., *Dodecatheon meadia* L., *Liatris pycnostachya* Michx., *Phlox pilosa* L., *Silphium terebinthinaceum* Jacq., *Solidago riddellii* Frank, *Sorghastrum nutans* (L.) Nash, and *Zizia aurea* (L.) Koch.

The Illinois Natural Areas Inventory file on Gavin Bog indicates that a fen community is present; however, several indicator species of calcareous fens (the only fen type identified in Illinois by the INAI) appear to be absent from the study area: *Cirsium muticum* Michx., *Gentiana procera* Holm, *Parnassia glauca* Raf., *Pedicularis lanecolata* Michx., *Potentilla fruticosa* L., and *Solidago ohioensis* Riddell. The apparently erroneous report of this interesting community type in the study area is probably due to the presence of *Cypripedium candidum* Muhl. in the mesic prairie, a species that is sometimes found in (but not restricted to) calcareous fens.

The prairie as a whole, about 2.6 hectares (6.4 acres), has the greatest diversity of the communities studied, with 140 vascular plant taxa. The species numbers found in the other community classes studied are less than half this number. Sixty-six species were recorded from the forested, tall-shrub, and low-shrub bog communities in an area of about 7 hectares (17.5 acres). Sixty-seven species were recorded from the marsh in an area of approximately 5.9 hectares (14.5 acres) and 67 species were recorded from the sedge meadow in an area totalling about 0.7 hectares (1.7 acres).

SIMILARITY INDICES. The Sorensen's similarity indices compiled for bog and adjoining marsh communities at four Illinois bogs and one Indiana bog (Pinhook Bog) are summarized in Table 1. Despite certain weaknesses of such comparisons (e.g., the thoroughness of the reports may vary, lists were compiled at different times), they do indicate a surprisingly low vegetational similarity between the four Illinois sites, all occurring within 18.75 km (11.5 miles) of Gavin Bog. These data conflict with Curtis's suggestion (1959, p. 240) that the vegetation composition of bogs (conifer swamps) in close proximity are often very similar. His assessment appears to have been based only on a comparison of characteristic species found in bogs and not on total species composition. For

Table 1. Sorensen's similarity indices calculated for four Lake County, Illinois bogs and one Indiana bog (Pinhook). Marsh communities were included in the comparisons. Numbers represent % of floristic elements in common.

	Pinhook	Wauconda	Barrington	Volo
Gavin	39	39	31	41
Volo	36	45	35	
Barrington	32	33		
Wauconda	30			

instance, he reported that similarity values for bogs in Wisconsin, Minnesota, Michigan, and Illinois are over 80%; however, the Illinois data on which that comparison is based (Waterman, 1923) provide only a brief listing of species and these are primarily restricted to bogs. A comparison of a selected few characteristic bog species from the four Illinois communities reviewed above would yield a much higher similarity index than was achieved by comparing total species lists. Nevertheless, the most important plant families in Wisconsin bogs, Cyperaceae and Ericaceae (Curtis, 1959), are also the best represented plant families at Gavin Bog: 8 species of Cyperaceae and 5 species of Ericaceae.

One explanation for the low similarity indices between these plant communities can be traced to the wide use of the term "bog." Illinois bogs are originally calcareous and only later become acidic (Sheviak, 1974). Because acids are normally flushed away by moving water, acidification occurs in basins with weak or no outlets. These sites are characterized by *Sphagnum*-covered hummocks and include an Ericaceous shrub component. All bogs in Illinois are oligotrophic peatlands; they receive water from geogenous sources as well as from precipitation. Shallow basins on gentle gradients with hydrologic outlets can also form oligotrophic peatlands but do not become strongly acidic because moving water prevents a build-up of acids (Johnson, 1985). In Illinois, these sites are not colonized by *Sphagnum* spp., contain few if any Ericaceous shrubs, and probably remain calcareous with a nearly neutral pH. Wauconda Bog and Barrington Bog belong to this latter category, perhaps more appropriately classified as minerotrophic peatlands, or fen and marsh complexes. Wauconda Bog is forested with tamaracks and yellow birch and thus should be referred to as a forested fen (M. L. Bowles, pers. comm.). This distinction between oligotrophic peatlands in Illinois does not, however, explain the dissimilarity between the acid peatlands in

Table 2. Illinois Threatened and Endangered plants (Sheviak, 1981; Illinois Endangered Species Protection Board, 1989) found at Gavin Bog and Prairie Nature Preserve, Lake County, Illinois.

Species	Status in Illinois	Habitat
<i>Agropyron trachycaulum</i> (Link) Malte. var. <i>unilaterale</i> (Vasey) Malte.	E	mesic prairie
<i>Carex brunnescens</i> (Pers.) Poir. var. <i>sphaerostachya</i> (Tuckerm.) Kukenth.	E	forested bog, tall-shrub bog
<i>Carex atherodes</i> Spreng.	T	sedge meadow
<i>Carex trisperma</i> Dew.	E	low-shrub bog, tall-shrub bog, forested bog
<i>Chamaedaphne calyculata</i> (L.) Moench	T	low-shrub bog, forested-bog edge
<i>Cypripedium candidum</i> Muhl.	E	mesic prairie
<i>Cypripedium parviflorum</i> Salisb.	E	mesic prairie
<i>Eriophorum virginicum</i> L.	E	low-shrub bog
<i>Larix laricina</i> (DuRoi) K. Koch	T	forested bog
<i>Oenothera perennis</i> L.	E	old field
<i>Ribes hirtellum</i> Michx.	E	forested-bog edge
<i>Trientalis borealis</i> Raf.	T	forested bog, tall- shrub bog
<i>Vaccinium corymbosum</i> L.	E	forested bog, tall- shrub bog
<i>Vaccinium oxycoccos</i> L.	E	low-shrub bog, forested-bog edge
<i>Veronica scutellata</i> L.	T	marsh

Table 1 (Gavin, Volo, and Pinhook Bogs). We speculate that these differences are related to the individual disturbance histories of the sites, the fluctuation of water levels, and, with Pinhook Bog, phytogeographic separation.

State-listed Threatened and Endangered Plant Species

Ten Illinois Endangered and four Illinois Threatened species (taxa) were recorded from the Gavin Bog and Prairie Nature Preserve during this study (Table 2). An additional Illinois Threatened species, *Carex atherodes* Spreng., is reported from the sedge meadow (Bowles, 1988; unpubl. report, Morton Arboretum, Lisle, IL). Two species of the bog community, *Carex brunnescens*

var. *sphaerostachya* (Taft and Solecki, 1987) and *Vaccinium oxycoccos*, have not previously been included as members of the Illinois flora (Jones, 1963; Swink and Wilhelm, 1979; Mohlenbrock, 1986). An earlier collection of a specimen labelled *Carex brunnescens* (Evers 10338 & Evers 10342, ILLS) from nearby Volo Bog is actually *Carex canescens* L. var. *disjuncta* Fern., a species closely resembling *C. brunnescens*, which is also previously unreported for Illinois. *C. canescens* var. *disjuncta* is still present at Volo Bog, where it is surprisingly common in the forested bog zone (Taft & Solecki 2322, Taft & Solecki 2323, ILLS).

Vaccinium oxycoccos L., the small cranberry, has not been previously verified from Illinois. This species occurs in bogs and peatlands from Greenland and across northern North America to Alaska and south to West Virginia, Ohio, Wisconsin, Minnesota, Washington, and California (Fernald, 1950; Gleason, 1952). At Gavin Bog, it was locally common in the low-shrub bog and occasional at the transition zone between low-shrub bog and forested bog during the first two years of this study; however, we observed a marked reduction in the population during the last year of this study. Where formerly this trailing, slender-stemmed shrub had been frequent, growing interlaced with *Sphagnum* spp. on hummocks beneath *Chamaedaphne calyculata*, in 1989 only a few stems were observed, and these were among dead stems on dry hummocks. This reduction may be attributable to the 1988 drought. The population was mainly vegetative, and only a few flowering stems were seen during this study (Taft & Solecki 2238, Taft & Solecki 2239, ILLS). A vegetative specimen labelled *V. macrocarpon* was collected from Gavin Bog in 1971 (Sheviak 569, ILLS), but this material may actually be *V. oxycoccos*. Illinois Natural Areas Inventory (White, 1978) field data sheets report *V. macrocarpon* from Cedar Lake Bog and from Gavin Bog, but these determinations may have been based on vegetative material because these species flower infrequently in Illinois and the two taxa are difficult to distinguish vegetatively. *V. macrocarpon* may also be present at Gavin Bog in a vegetative condition, but until flowering material can be documented, this population should be referred to as *V. oxycoccos*.

The small cranberry has been reported twice before from Illinois (Waterman, 1926; Wascher, 1934, M.S. thesis, University of Illinois, Champaign-Urbana). Wascher (1934, M.S. thesis, University of Illinois, Champaign-Urbana) lists *V. oxycoccos*

among 67 species of Illinois peat bogs. His inclusion of *Vaccinium oxycoccos* is questionable since he did not cite and apparently did not collect a voucher specimen and gives no specific location information other than peat bogs in Illinois. Furthermore, his list does not include *V. macrocarpon*, a State-endangered species known from four or five Illinois bogs (Sheviak, 1981). Waterman (1926) reported *V. oxycoccos* from a floating mat at Cedar Lake Bog in Lake County; however, no voucher specimen is referenced. Further, there is a specimen of *V. macrocarpon* (Evers 4634, ILLS) from Cedar Lake Bog.

Vaccinium oxycoccos is regarded as an allotetraploid species that arose by hybridization between *V. macrocarpon* and *V. microcarpum* (Turcz.) Hook., and specimens of *V. oxycoccos* with characteristics of one of the former parents are frequently found (Gleason, 1952; Wood, 1961). One specimen of flowering material from Gavin Bog (Taft & Solecki 2239, ILLS) has a pair of large (3.7 and 3.5 mm long), greenish bracts on one pedicel, a characteristic of *V. macrocarpon*; however, an adjacent pedicel on the same plant has small (1.6 and 1.7 mm long), pale yellow bracts typical of *V. oxycoccos*. The bracts are attached at or below the middle on both pedicels, a characteristic of *V. oxycoccos*. Furthermore, the pedicels on both flowering specimens range in length from 4 to 6 cm. The pedicels for *V. macrocarpon* are typically 1 to 3 cm long (Gleason, 1952; pers. obs.). Other vegetative and flower characteristics correspond with *V. oxycoccos*. Taft & Solecki 2238 is typical *Vaccinium oxycoccos*.

Vaccinium oxycoccos and *Carex brunnescens* var. *sphaerostachya* were recently listed by the Illinois Endangered Species Protection Board as endangered in Illinois (Illinois Endangered Species Protection Board, 1989). *Carex canescens* var. *disjuncta* has been proposed for listing as endangered in the State in 1990 (Illinois Endangered Species Protection Board, unpubl. memo., 1989).

Taxonomic Summary

Three hybrids and 245 plant species representing 68 families and 158 genera were identified in the wetland and prairie communities at Gavin Bog and Prairie Nature Preserve (Appendix). The major plant groups were represented as follows: 10 vascular cryptogams, 1 gymnosperm, 72 monocotyledons, and 165 dicotyledons. The three largest plant families were the Cyperaceae and

Asteraceae, each with 34 species, and the Poaceae with 20 species. *Carex* was the largest genus, represented by 22 species. Fourteen species of vascular plants recorded during this study (5.7% of the total) are alien to North America (Swink and Wilhelm, 1979).

Ecological and Management Considerations for the Bog Communities

The prairie has been managed using controlled fire and brush cutting with excellent results since 1977. Prior to management, the suppression of fire had resulted in the encroachment of woody plants throughout much of the prairie (Broulliard, pers. comm.). Now, shrubs have been reduced to scattered individuals and occasional small thickets. No management has occurred in the sedge meadow, marsh, or bog communities. The exotic shrub *Rhamnus frangula* (glossy buckthorn) with occasional *Ilex verticillata* form dense, nearly impenetrable, thickets throughout the tall-shrub and forested-bog zones. Glossy buckthorn was first recorded in Illinois in 1912, where it was found well established in Cook County (Sherff, 1912). By 1955, this Eurasian species was known from five primarily northeastern Illinois counties, including Lake County (Jones and Fuller, 1955). By 1978, it was known from 18 counties (Mohlenbrock and Ladd, 1978). European starlings are strongly implicated as the primary dispersal agent (Howell and Blackwell, 1977). Because the fruits of this species can float for several weeks (Ridley, 1930), water can also aid in dispersal.

Rhamnus frangula may have become established in the bog following grazing disturbance. Attempts at draining portions of the wetlands have occurred, and the water table in the bog may have been lowered at some time. A former landowner reported that Gavin Bog was much drier during the 1950's when it was grazed (Broulliard, pers. comm.). This dry period may have stressed the native tall shrubs bordering the forested-bog community and, together with grazing disturbance, created an opportunity for the establishment of the aggressive *R. frangula*. Precipitation deficits occurred in the 1950's, and seven of the eleven years from and including 1948 to 1958 had below average rainfall at Antioch, Illinois, the nearest reporting station to Gavin Bog (U.S. Department of Commerce, Weather Bureau data).

Glossy buckthorn branches profusely at the base and dead stems are often found among smaller, live stems. Because of this die-

back habit, it may be impossible to determine when buckthorn became established in the bog. One of the larger stems found, a living stem 4.5 cm in diameter at the base, had 39 growth increments. If these growth increments are annual growth rings, *Rhamnus frangula* has been in Gavin Bog at least since about 1950.

The composition of the tall-shrub zone in Illinois bogs prior to the invasion of *Rhamnus frangula* has been briefly described (Waterman, 1921, 1923, 1926). Important components included *Aronia melanocarpa*, *Betula pumila*, *Cornus stolonifera*, *Ilex verticillata*, *Toxicodendron vernix*, and *Vaccinium corymbosum*. This zone is believed to be a naturally occurring and stable community (Sheviak and Haney, 1973). The tall-shrub bog zone that existed at Gavin Bog before the invasion of *Rhamnus frangula* was probably dominated by *Ilex verticillata* with common to occasional *Aronia melanocarpa*, *Betula pumila*, *Vaccinium corymbosum*, and *Cornus stolonifera*.

Some populations of the rare species in Gavin Bog (*Vaccinium oxycoccos*, *V. corymbosum*, *V. myrtilloides*, *Ribes hirtellum*, and *Betula pumila*) may be limited by the shading and competitive effects of *Rhamnus frangula*. We found only single specimens of the last two species listed, both on the margin of the tall-shrub and forested-bog zone. The three *Vaccinium* species occur primarily in and adjacent to the low-shrub zone where light appears to be more available throughout the growing season. The availability of light is a controlling factor in bog community composition (Gates, 1942; Dansereau and Segadas-Vianna, 1952; Schwintzer and Williams, 1974), and in this regard, fire has been important in the vegetational composition of many more northern bogs (Gates, 1942). *Rhamnus* thickets and the tamarack-dominated canopy of the forested-bog zone shade the borders of the small low-shrub zone, which contains three Illinois Endangered plant species and one Illinois Threatened species (Table 1). We were unable to locate *Sarracenia purpurea* (Illinois Endangered), formerly reported as a single clump from the low-shrub zone (Illinois Natural Areas Inventory files). This species may have been eliminated from Gavin Bog due to increased shading. Pitcher plants, for example, have been eliminated from a Michigan bog because of increased shading (Schwintzer and Williams, 1974). The other species (*Toxicodendron vernix* and *Rhamnus alnifolia*) we did not find that were reported from the bog may also have been eliminated by competition from glossy buckthorn. The low-

shrub zone at Gavin Bog evidently was much larger than at the time of this study. In an area adjacent to the small low-shrub zone, *Chamaedaphne calyculata* is a common understory species with glossy buckthorn and tamaracks forming the overstory. The latter two species appear to have invaded a low-shrub zone dominated by *C. calyculata*. Low-shrub zones in bogs are prone to invasion by tall shrub species and tamarack, which shade and eventually eliminate the shade-intolerant low-shrub species like *C. calyculata* (Gates, 1942; Schwintzer and Williams, 1974). Glossy buckthorn is currently invading the remaining low-shrub zone at Gavin Bog. Judging from the rate of change observed in a Michigan bog where a low-shrub zone advanced to tall-shrub and forested-bog stages in just 70 years (Schwintzer and Williams, 1974), prescribed fires that eliminate or reduce the cover of tall-shrub species may be necessary to maintain low-shrub zones in bogs, particularly where low-shrub zones persist in bogs lacking open-water areas.

Species apparently favored by the shade of the tamarack and tall-shrub zone include *Carex trisperma*, *C. brunnescens*, and *Trientalis borealis*. These species are distributed throughout much of the forested-bog zone, while the two *Carex* species also occur throughout portions of the tall-shrub zone. Similar findings are reported for a Michigan bog (Schwintzer and Williams, 1974).

Rhamnus frangula readily resprouts following cutting (R. R. Heidorn 1989, Illinois Department of Conservation, pers. comm.). Efforts to control the resprouting of *R. frangula* and another exotic buckthorn species (*R. cathartica* L.) with stump-treatment herbicides have been successful without apparently disturbing adjacent vegetation (Kline, 1981; Apfelbaum, 1984; Hefty, 1984). A localized cutting and herbiciding of *R. frangula* around the low-shrub zone may retard the closing in of this area. However, these benefits may only be short-lived because seedlings of *R. frangula* are common on sphagnum hummocks throughout the bog. Glossy buckthorn seedlings, however, were less common in the low-shrub zone at the time of this study.

Fire is effective in killing seedlings and small individuals of *Rhamnus frangula* (Heidorn, 1988; unpubl. report to the Illinois Nature Preserves Commission) but may not be sufficient to kill seedlings in saturated sphagnum hummocks. Without fire, seedlings of *R. frangula* would probably quickly join the tall-shrub stratum. *Rhamnus frangula* seedlings are too numerous at Gavin

Bog to control with herbicides without jeopardizing populations of threatened and endangered species. Although fire modifies and/or retards some community development in Michigan bogs, it usually does not prevent the expression of bog communities where conditions are suitable for their development (Gates, 1942).

In Michigan, recolonization patterns in severely burned bogs included a primary state dominated by *Epilobium angustifolium* L., with occasional *Conyza canadensis* (L.) Cronq. and *Rumex acetosella* L. Subsequent stages included *Rubus* species, while aspen often colonized these sites following a bramble association (Gates, 1942). On the other hand, presumably following a less severe fire where fire-sensitive tamaracks were not eliminated, the *Chamaedaphne* association regenerated itself and tamarack colonization occurred on any open site (Gates, 1942). In Wisconsin, bogs that have been burned have developed into a bog/sedge meadow hybrid community type (Curtis, 1959). No data are available on the vegetational response to fire in Illinois bogs. Experimental prescribed fires in Illinois bogs should be avoided when water levels are low, because the peat could be damaged or destroyed.

The long-term persistence of many of the rare floristic elements in Gavin Bog is dependent on a form of management that reduces the density of *Rhamnus frangula*. The shade-intolerant tamarack, for instance, is dependent on open areas for seedling establishment (Gates, 1942). *Vaccinium oxycoccos*, *V. myrtilloides*, *V. corymbosum*, *Betula pumila*, *Eriophorum virginicum*, *Ribes hirtellum*, and possibly *Sarracenia purpurea*, if still present in a suppressed vegetative condition or in the seed bank, may also benefit from management efforts that open up portions of the bog, either through cutting and stump treatment and/or fire. If portions of the bog were left unburned, the shade-tolerant species *Carex trisperma*, *C. brunnescens*, and *Trientalis borealis* would probably recolonize burned sites if a fire were to eliminate populations of these species. It is unlikely, however, that any known management practice will completely replace *R. frangula* with native species.

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LITERATURE CITED

- APFELBAUM, S. I. 1984. Buckthorn control with herbicide tested (Illinois). Restoration and Management Notes 2: 36.
- CURTIS, J. T. 1959. The Vegetation of Wisconsin. An Ordination of Plant Communities. University of Wisconsin Press, Madison.
- DANSEREAU, P. AND F. SEGADAS-VIANNA. 1952. Ecological study of the peat bogs of eastern North America. 1. Structure and evolution of vegetation. Canad. J. Bot. 30: 490-520.
- FERNALD, M. L. 1950. Gray's Manual of Botany, 8th ed. American Book Co., New York.
- GATES, F. C. 1942. The bogs of northern lower Michigan. Ecol. Monogr. 12: 214-254.
- GLEASON, H. A. 1952. The New Britton and Brown Illustrated Flora of the Northeastern United States and Adjacent Canada, Vol. 3. Hafner Press, New York.
- HEFTY, R. 1984. Buckthorn control with 2,4-D/2,4-DP (Wisconsin). Restoration and Management Notes 2: 36.
- HOWELL, J. A. AND W. H. BLACKWELL, JR. 1977. The history of *Rhamnus frangula* (glossy buckthorn) in the Ohio flora. Castanea 42: 111-115.
- ILLINOIS ENDANGERED SPECIES PROTECTION BOARD. 1989. Checklist of Endangered and Threatened Animals and Plants of Illinois. Illinois Endangered Species Protection Board and the Illinois Department of Conservation, Springfield.
- JOHNSON, C. W. 1985. Bogs of the Northeast. University Press of New England, Hanover and London.
- JONES, G. N. 1963. Flora of Illinois, 3rd ed. American Midland Naturalist Monograph 7. University of Notre Dame, Notre Dame, IN.
- AND G. D. FULLER. 1955. Vascular Plants of Illinois. University of Illinois Press, Urbana-Champaign.
- KLINE, V. 1981. Control of honeysuckle and buckthorn in oak forests (Wisconsin). Restoration and Management Notes 1: 18.
- LINEBACK, J. A. 1979. Quaternary deposits of Illinois. Illinois State Geological Survey, Urbana. Map 1:500,000.
- MOHLENBROCK, R. H. 1986. Guide to the Vascular Flora of Illinois, revised and

- expanded edition. Southern Illinois University Press, Carbondale and Edwardsville.
- AND D. M. LADD. 1978. Distribution of Illinois Vascular Plants. Southern Illinois University Press, Carbondale and Edwardsville.
- MUELLER-DOMBOIS, D. AND H. ELLENBERG. 1974. Aims and Methods of Vegetation Ecology. John Wiley and Sons, New York.
- PASCHKE, J. E. AND J. D. ALEXANDER. 1970. Soil Survey of Lake County, Illinois. USDA Soil Conservation Service.
- RIDLEY, H. N. 1930. The Dispersal of Plants Throughout the World. Reeve and Company, Ashford, Kent, U.K.
- SCHWEGMAN, J. E. 1973. Comprehensive Plan for the Illinois Nature Preserves Commission. Part 2: The Natural Divisions of Illinois. Illinois Nature Preserves Commission, Rockford.
- SCHWINTZER, C. R. AND G. WILLIAMS. 1974. Vegetation changes in a small Michigan bog from 1917 to 1972. *Am. Midl. Nat.* 92: 447–459.
- SHELFORD, V. E. 1963. The Ecology of North America. University of Illinois Press, Urbana.
- SHERFF, E. E. 1912. Range extension of *Rhamnus frangula* and *Sporobolus asperifolius*. *Rhodora* 14: 227–228.
- SHEVIK, C. 1974. An introduction to the ecology of the Illinois Orchidaceae. Illinois State Museum Scientific Papers XIV. Springfield.
- . 1981. Endangered and threatened plants, pp 70–179. *In*: M. L. Bowles, V. E. Diersing, J. E. Ebinger, H. C. Schultz, Eds., Endangered and Threatened Vertebrate Animals and Vascular Plants of Illinois. Illinois Department of Conservation, Springfield.
- AND A. HANEY. 1973. Ecological interpretations of the vegetation patterns of Volo Bog, Lake County, Illinois. *Trans. Illinois State Acad. Sci.* 66: 99–112.
- SWINK, F. AND G. WILHELM. 1979. Plants of the Chicago Region, rev. ed. The Morton Arboretum, Lisle, IL.
- TAFT, J. B. AND M. K. SOLECKI. 1987. *Carex brunnescens* in Illinois. *Trans. Illinois State Acad. Sci.* 80: 345–346.
- U.S. DEPARTMENT OF COMMERCE, WEATHER BUREAU. Climatological Data. Illinois Section, Vol. LIII to Vol. LXIII.
- VOSS, J. 1934. Postglacial migration of forests in Illinois, Wisconsin, and Minnesota. *Bot. Gaz.* 96: 3–43.
- WATERMAN, W. G. 1921. Preliminary report on the bogs of northern Illinois. *Trans. Illinois State Acad. Sci.* 14: 79–84.
- . 1923. Report on the bogs of northern Illinois. *Trans. Illinois State Acad. Sci.* 16: 214–225.
- . 1926. Ecological problems from the sphagnum bogs of Illinois. *Ecology* 7: 255–272.
- WHITE, J. 1978. Illinois Natural Areas Inventory Technical Report, Vol. 1. Survey Methods and Results. Illinois Natural Areas Inventory, Urbana.
- WILHELM, G. S. 1980. Report on the special vegetation of the Indiana Dunes National Lakeshore. Indiana Dunes National Lakeshore Research Program Report 8001. National Park Service, Dept. of Interior Midwest Region.
- WILLMAN, H. B. 1971. Summary of the geology of the Chicago area. Illinois State Geological Survey Circular 460.

WOOD, C. E. 1961. The genera of Ericaceae in the southeastern United States. J. Arnold Arb. 42: 10-80.

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APPENDIX

Vascular flora of wetland and prairie communities at Gavin Bog Nature Preserve, Lake County, Illinois. A = alien, E = State endangered, S = State record (endangered), T = State threatened; bo = bog, ma = marsh, of = old field, pr = prairie, sm = sedge meadow; a = abundant, c = common, o = occasional, u = uncommon, r = rare.

Equisetaceae

- Equisetum arvense* L.—ma, pr; c
Equisetum fluviatile L. var. *unilaterale* (Vasey) Malte—ma, sm; c
Equisetum hyemale L.—ma; o
Equisetum laevigatum A. Br.—pr; r
Equisetum × *ferrissii* Clute—ma; r

Osmundaceae

- Osmunda regalis* L.—bo; o
Osmunda cinnamomea L.—bo; c

Thelypteridaceae

- Thelypteris palustris* Schott—bo, sm; c

Aspleniaceae

- Onoclea sensibilis* L.—bo; o
Dryopteris carthusiana (Villars) H. P. Fuchs—bo; c

Pinaceae

- Larix laricina* (DuRoi) K. Koch
T—bo; c

Typhaceae

- Typha latifolia* L.—ma; a

Sparganiaceae

- Sparganium androcladum* (Engelm.) Morong—ma; u
Sparganium eurycarpum Engelm.—sm, ma; o

Alismaceae

- Sagittaria latifolia* Willd.—bo, ma; c
Alisma plantago-aquatica L.—ma, bo; o

Poaceae

- Bromus kalmii* Gray—pr; r
Poa pratensis L. A—pr; o
Poa compressa L. A—pr, sm; o
Poa trivialis A—pr; r
Sphenopholis obtusata (Michx.) Scribn.—pr; u
Calamagrostis canadensis (Michx.) Beauv.—ma, sm, pr; a
Agrostis alba L. A—sm, pr, bo; o
Phalaris arundinacea L.—bo, ma, sm; c
Phleum pratense L. A—pr; r
Elymus canadensis L.—pr; o
Agropyron trachycaulum (Link) Malte var. *unilaterale* (Vasey)
Malte E—pr; r

Glyceria septentrionalis Hitchc.—
bo, ma, sm; c
Glyceria striata (Lam.) Hitchc.—pr,
sm; o
Dichanthelium acuminatum (Sw.)
Gould & Clark var. *fasciculatum*
(Torr.) Freckm.—pr; r
Dichanthelium acuminatum (Sw.)
Gould & Clark var. *lindheimeri*
(Nash) Gould & Clark—
pr; o
Sorghastrum nutans (L.) Nash—
pr; c
Andropogon gerardii Vitm.—pr; c
Schizachyrium scoparium (Michx.)
Nash—pr; o
Spartina pectinata Link—pr,
sm; a
Leersia oryzoides (L.) Sw.—bo,
ma; c

Cyperaceae

Dulichium arundinaceum (L.)
Britt.—bo; o
Eleocharis cf. *macrostachya* Britt.—
pr; o
Eleocharis erythropoda Steud.—
ma; c
Eleocharis obtusa (Willd.) Schult.—
ma; c
Eleocharis elliptica Kunth. var.
compressa (Sull.) Drap. &
Mohlenbr.—pr; o
Scirpus acutus Muhl.—ma, sm; c
Scirpus heterochaetus Chase—
sm; o
Scirpus fluviatilis (Torr.) Gray—ma,
sm; c
Scirpus atrovirens Willd.—ma; o
Scirpus pendulus Muhl.—pr; o
Scirpus cyperinus (L.) Kunth—ma,
bo; o
Eriophorum virginicum L. E—
bo; o
Carex brunnescens (Pers.) Poir. var.
sphaerostachya (Tuckerm.)
Kukenth. S—bo; c
Carex sartwellii Dew.—pr, sm; c

Carex vulpinoidea Michx.—ma, pr,
sm; o
Carex stipata Muhl.—ma; o
Carex trisperma Dew. E—bo; o
Carex interior Bailey—pr; o
Carex scoparia Schk.—ma; c
Carex tribuloides Wahlenb.—pr,
sm, bo; o
Carex bebbii Olney—bo, ma, pr; o
Carex normalis Mackenzie—pr,
ma, sm; o
Carex tenera Dew.—pr; u
Carex festucacea Schk.—sm; c
Carex stricta Lam.—pr, sm; a
Carex buxbaumii Wahlenb.—ma,
pr, sm; c
Carex lasiocarpa Ehrh.—pr; o
Carex lanuginosa Michx.—ma, pr,
sm; o
Carex granularis Muhl.—pr; o
Carex tetanica Schk.—pr; o
Carex lacustris Willd.—ma, sm; o
Carex atherodes Spreng.—sm; o
Carex comosa Boott—ma; r
Carex lupulina Muhl.—bo; o

Araceae

Acorus americanus (Raf.) Raf.—
ma; o

Lemnaceae

Spirodela polyrhiza (L.) Schleid.—
ma; o
Lemna minor L.—ma; c

Juncaceae

Juncus dudleyi Wieg.—pr; o

Liliaceae

Allium cernuum Roth—pr; o
Trillium recurvatum Beck—pr; r
Lilium michiganense Farw.—pr; r
Smilacina stellata (L.) Desf.—pr; c
Hypoxis hirsuta (L.) Cov.—pr; o

Iridaceae

Iris shrevei Small—bo, ma, pr,
sm; c
Sisyrinchium albidum Raf.—pr; o

Orchidaceae

- Cypripedium parviflorum* Salisb.
E—pr; o
Cypripedium × *andrewsii* A. M.
Fuller—pr; r
Cypripedium candidum Muhl. E—
pr; o

Salicaceae

- Salix amygdaloides* Anderss.—ma,
sm; r
Salix alba L. A—sm; r
Salix rigida Muhl.—pr, sm; u
Salix glaucophylloides Fern.—
sm; o
Salix bebbiana Sarg.—sm, pr; o
Salix discolor Muhl.—pr, sm; o
Salix humilis Marsh.—pr; o
Salix petiolaris Sm.—ma, pr, sm; o
Populus tremuloides Michx.—pr; o

Betulaceae

- Betula papyrifera* Marsh.—bo; r
Betula pumila L.—bo; r

Corylaceae

- Corylus americana* Walt.—pr; r

Fagaceae

- Quercus alba* L.—bo; o
Quercus macrocarpa Michx.—pr; r

Urticaceae

- Boehmeria cylindrica* (L.) Sw.—
ma; o

Santalaceae

- Comandra umbellata* (L.) Nutt.—
pr; c

Polygonaceae

- Rumex crispus* L. A—pr; r
Rumex orbiculatus Gray—bo,
ma; o
Polygonum amphibium L.—ma,
sm; c

Caryophyllaceae

- Cerastium vulgatum* L. A—bo; r

Ranunculaceae

- Ranunculus sceleratus* L.—bo; r

- Ranunculus flabellaris* Raf.—ma,
sm; c

- Thalictrum dasycarpum* Fisch. &
Lall.—pr, sm; o

- Anemone virginiana* L.—pr, sm; o

Berberidaceae

- Podophyllum peltatum* L.—pr; c

Brassicaceae

- Cardamine bulbosa* (Schreb.)
BSP.—ma, pr; o

- Cardamine pensylvanica* Muhl.—
pr; r

- Rorippa islandica* (Oeder) Borbas
var. *fernaldiana* Butt. &
Abbe—ma; o

- Barbarea vulgaris* R. Br. A—pr; r

Grossulariaceae

- Ribes hirtellum* Michx. E—bo; r
Ribes americanum Mill.—bo, ma,
pr; o

Saxifragaceae

- Penthorum sedoides* L.—bo; r
Saxifraga pensylvanica L.—pr; o
Heuchera richardsonii R. Br.—
pr; o

Rosaceae

- Spiraea alba* DuRoi—ma, pr,
sm; o

- Crataegus succulenta* Schrad.—
pr; r

- Aronia melanocarpa* (Michx.) Ell.—
bo; c

- Rubus occidentalis* L.—bo; r

- Rosa multiflora* Thunb. A—bo,
sm; r

- Rosa carolina* L.—pr; o

- Rosa palustris* Marsh.—pr; o

- Fragaria virginiana* Duchesne—
pr; c

- Geum canadense* Jacq.—pr; r

- Potentilla palustris* (L.) Scop.—
ma; r

Fabaceae

- Lathyrus palustris* L.—pr, sm; o

- Apios americana* Medic.—pr; o

Melilotus alba Desr. N—pr; r
Desmodium canadense (L.) DC.—
 pr; o
Amphicarpa bracteata (L.) Fern.—
 pr; o
Strophostyles leiosperma (T. & G.)
 Piper—pr; o

Oxalidaceae

Oxalis stricta L.—pr; r

Geraniaceae

Geranium maculatum L.—pr; o

Polygalaceae

Polygala senega L.—pr; r

Euphorbiaceae

Euphorbia corollata L.—pr; r

Aquifoliaceae

Ilex verticillata (L.) Gray—bo,
 ma; c

Aceraceae

Acer saccharinum L.—bo, pr; r

Balsaminaceae

Impatiens cf. *capensis* Meerb.—
 bo; o

Rhamnaceae

Rhamnus cathartica L.—ma, pr; o
Rhamnus frangula L.—bo, ma, pr,
 sm; o-a

Vitaceae

Parthenocissus quinquefolia (L.)
 Planch.—sm; o
Vitis riparia Michx.—sm; o

Hypericaceae

Triadenum fraseri (Spach) Gl.—bo,
 pr; r

Violaceae

Viola pratincola Greene—pr, sm; c
Viola × *bernardii* Greene—pr, r
Viola pedatifida G. Don—pr; r
Viola mackloskeyi Lloyd spp. *pal-*
lens (Banks) M. S. Baker—
 bo; r

Lythraceae

Lythrum alatum Pursh—bo, ma, pr,
 sm; o
Lythrum salicaria L. A—bo, ma,
 sm; o-a

Onagraceae

Epilobium ciliatum Raf.—bo; o
Oenothera perennis L. E—of; r

Apiaceae

Eryngium yuccifolium Michx.—
 pr; o
Sanicula gregaria Bickn.—pr; r
Sanicula canadensis L.—pr; r
Oxypolis rigidior (L.) Coult. &
 Rose—ma; o
Zizia aurea (L.) W. D. J. Koch—
 pr; c
Sium suave Walt.—bo, ma; a
Cicuta maculata L.—pr, sm; o

Cornaceae

Cornus stolonifera Michx.—bo, pr,
 sm; c
Cornus obliqua Raf.—bo, ma; o
Cornus racemosa Lam.—bo; o

Pyrolaceae

Monotropa uniflora L.—bo; r

Ericaceae

Chamaedaphne calyculata (L.)
 Moench T—bo; c
Gaylussacia baccata (Wang.) K.
 Koch—bo; o
Vaccinium myrtilloides Michx.—
 bo; u
Vaccinium corymbosum L. E—
 bo; o
Vaccinium oxycoccos L. S—bo; o

Primulaceae

Dodecatheon meadia L.—pr; o
Lysimachia thyrsiflora L.—bo,
 ma; o
Lysimachia quadrifolia L.—sm; o
Trientalis borealis Raf. T—bo; o

Oleaceae

Fraxinus nigra Marsh.—bo, pr; r

Fraxinus pennsylvanica Marsh.—
bo; r

Gentianaceae

Gentiana andrewsii Griseb.—pr; r

Apocynaceae

Apocynum sibiricum Jacq.—pr,
sm; o

Asclepiadaceae

Asclepias incarnata L.—ma, sm; c

Convolvulaceae

Calystegia sepium (L.) R. Br.—
pr; r

Cuscutaceae

Cuscuta cf. *coryli* Engelm.—ma; r

Polemoniaceae

Phlox pilosa L.—pr; c

Boraginaceae

Lithospermum canescens (Michx.)
Lehm.—pr; r

Verbenaceae

Verbena hastata L.—sm; o

Lamiaceae

Mentha arvensis L. var. *villosa*
(Benth.) S. R. Stewart—bo, ma,
sm; c

Lycopus americanus Muhl.—ma;
o-c

Lycopus uniflorus Michx.—ma; c

Teucrium canadense L.—sm; o

Scutellaria galericulata L.—ma,
sm; c

Scutellaria lateriflora L.—bo; o

Monarda fistulosa L.—pr; r

Pycnanthemum virginianum (L.)
Dur. & Jacks.—sm; c

Glechoma hederacea L. A—bo; r

Stachys palustris L.—pr; o

Prunella vulgaris L.—pr; o

Solanaceae

Solanum dulcamara L. A—bo,
ma; a

Scrophulariaceae

Veronicastrum virginicum (L.)

Farw.—pr, sm; c

Veronica scutellata L. T—ma; o

Pedicularis lanceolata Michx.—
pr; o

Mimulus ringens L.—pr, sm; o

Castilleja coccinea (L.) Spreng.—
pr; o

Lentibulariaceae

Utricularia vulgaris L.—ma; c

Acanthaceae

Ruellia humilis Nutt.—pr; o

Plantaginaceae

Plantago major L. A—pr; r

Rubiaceae

Galium boreale L.—bo, pr, sm; c

Galium obtusum Bigel.—bo, pr; o

Galium tinctorium L.—ma; o

Galium triflorum Michx.—pr; o

Caprifoliaceae

Sambucus canadensis L.—bo,
sm; r

Lonicera morrowi Gray A—bo; r

Viburnum opulus L. A—pr; r

Viburnum lentago L.—pr, bo; r

Viburnum recognitum Fern.—bo; u

Campanulaceae

Campanula aparinoides Pursh—
ma, sm; o

Lobelia spicata Lam.—pr; o

Asteraceae

Ambrosia artemisiifolia L.—pr; r

Aster ericoides L.—pr; c

Aster novae-angliae L.—pr, sm; c

Aster pilosus Willd.—pr; o

Aster praealtus Poir.—pr; o

Aster puniceus L.—ma, sm; o

Aster simplex Willd.—pr; o

Erigeron philadelphicus L.—pr; r

Erigeron strigosus Muhl.—pr; o

Bidens cernua L.—ma; o

Bidens tripartita L.—ma; o

Cirsium sp.—pr; r

Eupatorium maculatum L.—ma, pr,
sm; o

Eupatorium perfoliatum L.—ma,
sm; o

Helenium autumnale L.—pr; o

Helianthus grosseserratus Mar-
tens—pr, sm; c

Helianthus rigidus (Cass.) Desf.—
pr; o

Krigia biflora (Walt.) Blake—pr; o

Liatris pycnostachya Michx.—pr; c

Liatris spicata (L.) Willd.—pr; o

Ratibida pinnata (Vent.) Barnh.—
pr; o

Rudbeckia hirta L.—pr; o

Rudbeckia subtomentosa Pursh—
pr; o-c

Rudbeckia triloba L.—sm, pr; u

Senecio aureus L.—pr; c

Silphium integrifolium Michx.—
pr; o

Silphium laciniatum L.—pr; c

Silphium terebinthinaceum Jacq.—
pr; a

Solidago gigantea Ait.—sm; o

Solidago riddellii Frank—pr; o

Solidago rigida L.—pr; o

Euthamia graminifolia (L.)
Salisb.—sm; o

Taraxacum officinale Weber—pr; r

Vernonia fasciculata Michx.—pr; o